Summary of FY2001 Water Quality Monitoring for Isoxaflutole (Balance and Epic herbicides) in Nebraska

Nebraska Department of Agriculture
Bureau of Plant Industry

The herbicide isoxaflutole (the active ingredient in Balance and Epic herbicides) was registered for use on field corn before the 1999 growing season. Because of concerns about its

mobility, potential health effects, and phytotoxicity, it was conditionally registered for three years (1999-2001). After this period, the U.S. Environmental Protection Agency (EPA) was to evaluate the results of monitoring studies and modeling to determine continued registration.

In 2001, the Nebraska Department of Agriculture (NDA) again requested the assistance of local, state, and federal agencies involved in water quality monitoring to obtain samples for the purpose of characterizing isoxaflutole's movement in Nebraska waters. A number of organizations volunteered to collect water quality samples; most were obtained in conjunction with ongoing monitoring within their respective offices (Table 1). A total of 840 samples were collected from 248 sites across Nebraska (Fig. 1). Samples were collected from both ground and surface waters, however no samples were collected from runoff water, wetlands, or irrigation reuse pits in 2001. The presence of isoxaflutole or its metabolites was detected in 14% of the samples (Table 2). As was the case the previous year, the largest number of detections were found in creeks or rivers and this category again represented a large percentage of the samples collected (75%).

Table 1. Summary of data contributors.

Contributor	Number of Sites	Number of Samples
Little Blue NRD	19	19
Lower Platte North NRD	101	101
NDEQ	75	663
Nemaha NRD	2	2
Upper Big Blue NRD	19	19
USGS	32	38

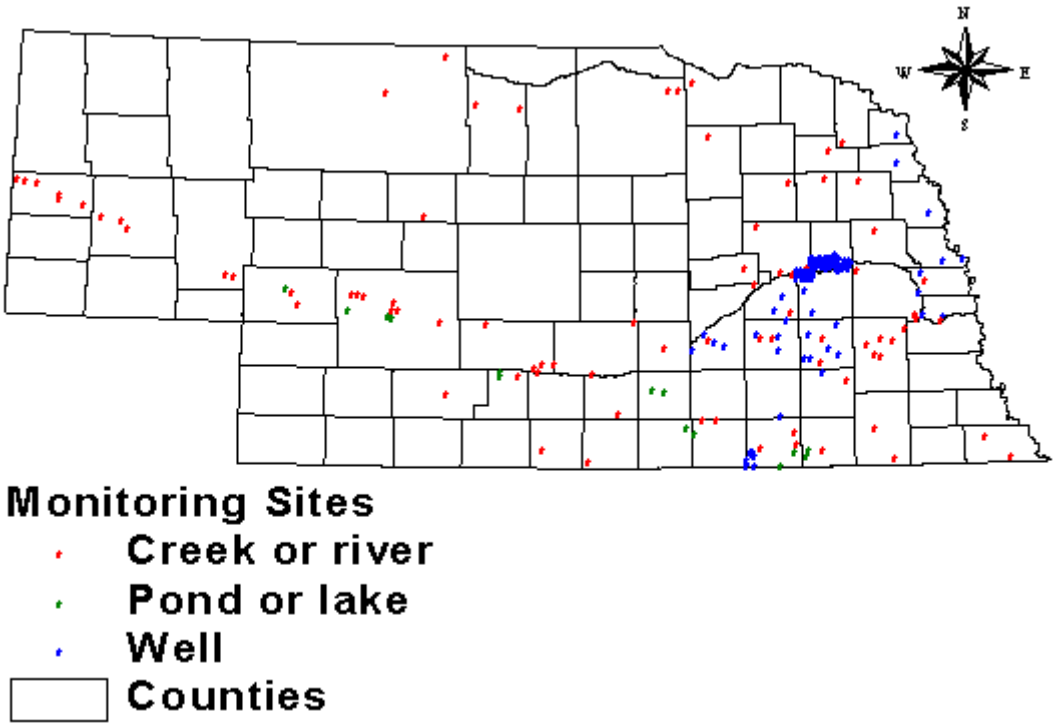

Figure 1. Sites sampled for isoxaflutole.

Table 2. Summary of samples analyzed for isoxaflutole and its metabolites in Nebraska.

Type of Site	Number of sites or sampling points	Number of samples	Number of detections§
Ground Water	145	146	3
Irrigation Reuse Pit	0	0	-
Ag Runoff	0	0	-
Pond or Lake	15	64	5
River or Creek	90	632	108
Totals	248	840	116

§ - Includes all samples with detectable levels of isoxaflutole or its metabolites. The level of detection for these samples was 3 parts per trillion (ppt). The level of quantification, however, is 10 ppt.

It should be noted that the method of analysis has a very low detection level. Concentrations as low as three parts per trillion (ppt) can be detected (limit of detection) and concentrations of 10 ppt or greater can be quantified (limit of quantification). EPA has set 3.1 parts per billion (ppb, or 3100 ppt) as the drinking water level of comparison.

Table 3. Average concentration of isoxaflutole and its metabolites by type of monitoring site, in parts per trillion (ppt). Samples having detectable concentrations greater than 3 ppt but below the level of quantification (10 ppt) were entered as 5 ppt.

Type of Site (number of samples)	Isoxaflutole	202248 metabolite	203328 metabolite
Ground Water (146)	0	0.27	0.09
Irrigation Reuse Pit (0)	-	-	-
Ag Runoff (0)	-	-	-
Pond or Lake (64)	0	8.34	2.57
River or Creek (632)	0	1.71	1.49
Overall Average (840)	0	1.96	1.34

Table 4. Average concentration of isoxaflutole and its metabolites for those samples with detectable levels; the number of samples is in parentheses. Samples having detectable concentrations of greater than 3 ppt but below the level of quantification (10 ppt) were entered as 5 ppt. (n = 116)

Type of Site	Isoxaflutole	202248 metabolite	203328 metabolite
Ground Water	0	12.0 (3)	10.2 (1)
Irrigation Reuse Pit	-	-	-
Ag Runoff	-	-	-
Pond or Lake	0	106.8 (5)	34.0 (5)
River or Creek	0	13.3 (90)	13.0 (92)
Wetland	-	-	-
Overall Average	0	16.8 (98)	11.5 (98)

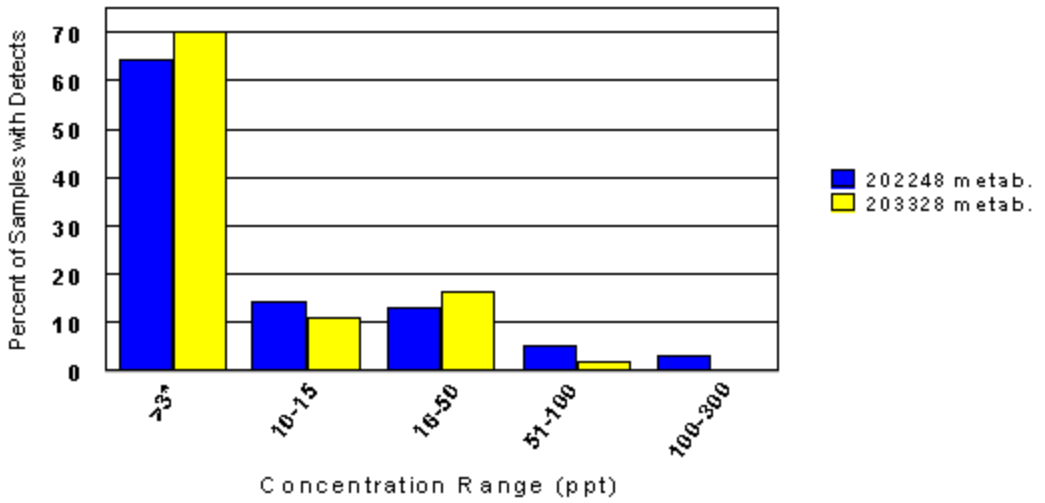

Figure 2. Proportion of detects grouped by analyte. The category ">3" are for those samples that were detectable but less than the quantification limit. n = 116 samples having a detect.

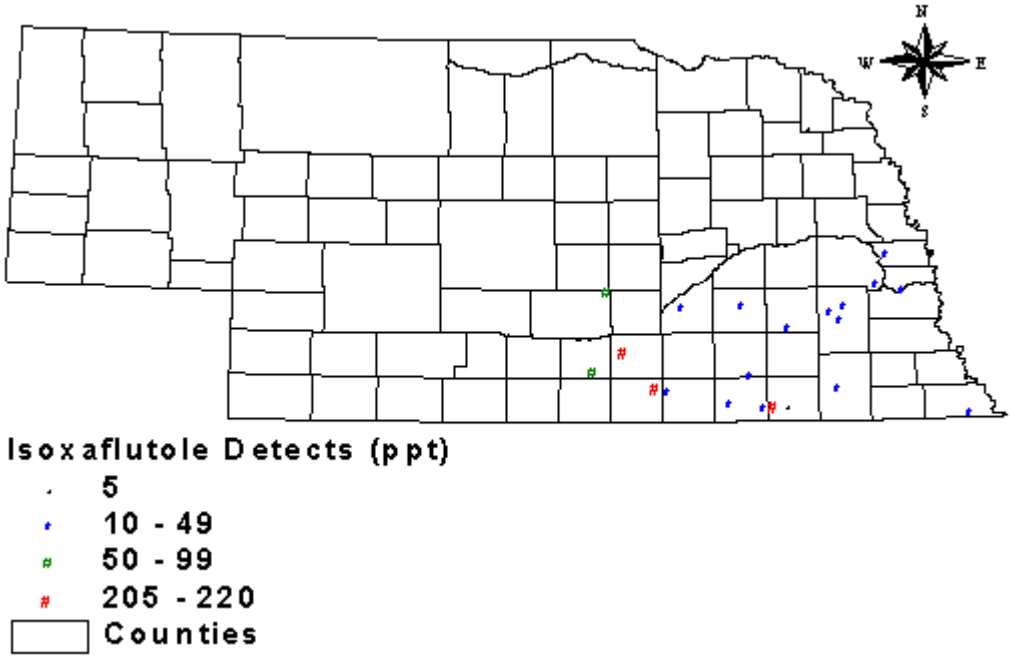

Figure 3. Sites having detects showing concentrations of all analytes summed for each location. Detects greater than 3 ppt but less than 10 ppt are labeled as "5".

Table 5. Comparison of application rates, chemical properties, and chronic toxicity of commonly-used corn herbicides[§].

Common Name	Maximum Application Rate on Corn[¶] (oz dry active ingredient [a.i.]/acre/year)	Estimated Use Rate on Neb. Corn (2000; oz a.i./acre/yr)[21]	% of Neb. Corn Acres Receiving Application (2000; 8.5 million total)[21]	Solubility (mg/L or ppm)	Half-Life (days)	K_{OC}[†] (ml/g)	Leaching Potential[★]	Solution Runoff Potential	Adsorbed Runoff Potential	Human Toxicity (ppb)[‡, 22]
acetochlor	48	25	17	223	14	150	Intermediate	Intermediate	Low	21 CHCL[♣]
alachlor	62	27	5	240	15	170	Intermediate	Intermediate	Low	2 MCL
atrazine	40	18	80	33	60	100	High	High	Intermediate	3 MCL
desethyl atrazine	-	-	-	3200[23]	?	?	-	-	-	-
desisopropyl atraz.	-	-	-	670[23]	?	?	-	-	-	-
bromoxynil	8	4[*]	1[*]	0.08	7	10000	Low	Low	Intermediate	140 HA[♣]
cyanazine[**]	16	17	2	170	14	190	Intermediate	Intermediate	Low	1 HA
dicamba	12	3	16	400000	14	2	High	Intermediate	Low	200 HA[♣]
dimethenamid	24	16	5	1174	20	160	Intermediate	Intermediate	Low	35 HA[♣]
glyphosate	60	11	3	12000	47	24000	Very Low	High	High	700 MCL
isoxaflutole	2.25	0.96	3	3.5 (6.2)[24]	3	147(134)[24]	Low	Intermediate	Low	3.1 DWLOC
202248[***]	-	-	-	326[24]	61[25]	17[24]	High	High	High	-
203328[***]	-	-	-	?	977[25]	?	-	-	-	-
metolachlor	96	18	45	530	90	200	High	High	Intermediate	100 HA
nicosulfuron	0.99	0.48	12	2200	21	30	High	Intermediate	Low	8750 HA[♣]
rimsulfuron	0.5	0.2	10	7300	10	47	Intermediate	Intermediate	Low	112 HA[♣]
simazine	64	-	-	6.2	60	130	High	High	Intermediate	4 MCL

§ - Chemical properties and rankings are from USDA NRCS' Pesticide Screening Tool[26], except as noted. Application rates are from product labels registered with the Nebraska Department of Agriculture.

¶ - Rate is often dependent on a combination of soil types, the formulation of product, the number and method of applications, and whether the product is used by itself or in combination with other herbicides.

† - Soil organic carbon sorption coefficient; measures the affinity of pesticides to sorb to organic carbon. The higher the value, the greater the tendency to attach to and move with soil.

★ - Pesticide Leaching Potential (PLP) = If log_val >= 2.8 then PLP = High; otherwise if log-val < 0.0 or SOL < 1 or HL <= 1 then PLP = Very Low; otherwise if log_val <= 1.8 then PLP = Low; otherwise PLP = Intermediate. (where log_val = (log (HL) * (4 - log (K_{OC})); HL = Half-Life; K_{OC} = sorption coefficient;, and SOL =solubility. See the glossary in WIN-PST for the algorithms used to calculate the solution runoff and adsorption runoff potential.

‡ - MCL = Maximum Contaminant Level; the maximum permissible level of a contaminant in water delivered to users of a public water system. An enforceable standard;
DWLOC = Drinking Water Level of Comparison; the theoretical upper limit of "acceptable" exposure after considering food and residential exposures as sources. Not a regulatory standard for drinking water;
HA = Health Advisory level; an estimate of acceptable drinking water levels for a chemical substance based on health effects information. Not a legally enforceable Federal standard, but serves as technical guidance to assist Federal, state, and local officials.
HA[♣] = Health Advisory level calculated by WIN-PST using the EPA method for calculating health advisories. See the glossary in WIN-PST for additional references.
CHCL[♣] = Chronic Human Carcinogen Level; calculated by WIN-PST, is comparable to an MCL level. See the glossary in WIN-PST for additional references.

* - 1999 estimates; none given for 2000.

** - Product was included in the proposed PMP rule but its registration is in the process of being canceled and its remaining inventory will be depleted.

***- These are degradates of isoxaflutole.

More samples were collected this year from shallow wells. Eighty-one wells out of 119 with known depths were less than 100 feet deep. However, because samples were obtained from volunteers as part of ongoing efforts not specifically targeting isoxaflutole, many samples were likely taken at sites without pesticide applications of isoxaflutole. As was the case the previous year, very few samples were collected near known applications of isoxaflutole (47 for 2000; 1 for 2001).

References

21. USDA National Agricultural Statistics Service. 2001. 2000 Nebraska Agricultural Chemical Usage. (http://www.agr.state.ne.us./agstats/special/agchem01.PDF)

22. U.S. Environmental Protection Agency. (Summer 2000). *Drinking Water Regulations and Health Advisories*. EPA-822-B-00-001. http://www.epa.gov/ost/drinking/standards/ (4 September, 2001)

23. Syracuse Research Corporation. (August, 2001). Physical Properties Database, Interactive PhysProp Database Demo. (http://esc.syrres.com/interkow/physdemo.htm) (4 September, 2001)

24. U.S. Environmental Protection Agency. (September 1998). *Pesticide Fact Sheet.* (http://www.epa.gov/opprd001/factsheets/isoxaflu.htm) (22 December, 2000)

25. Taylor-Lovell, S., G. Sims, L. Wax, and J. Hassett. (2000). *Hydrolysis and soil adsorption of the labile herbicide isoxaflutole.* Environmental Science and Technology. 34:3186-3190.

26. USDA Natural Resources Conservation Service, National Water and Climate Center. July 7, 2000. Windows Pesticide Screening Tool (WIN-PST). Version 2.0050. (http://www.wcc.nrcs.usda.gov/water/quality/frame/pestmgt.html)